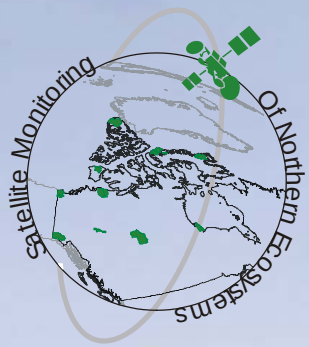
Satellite Monitoring of Northern Ecosystems

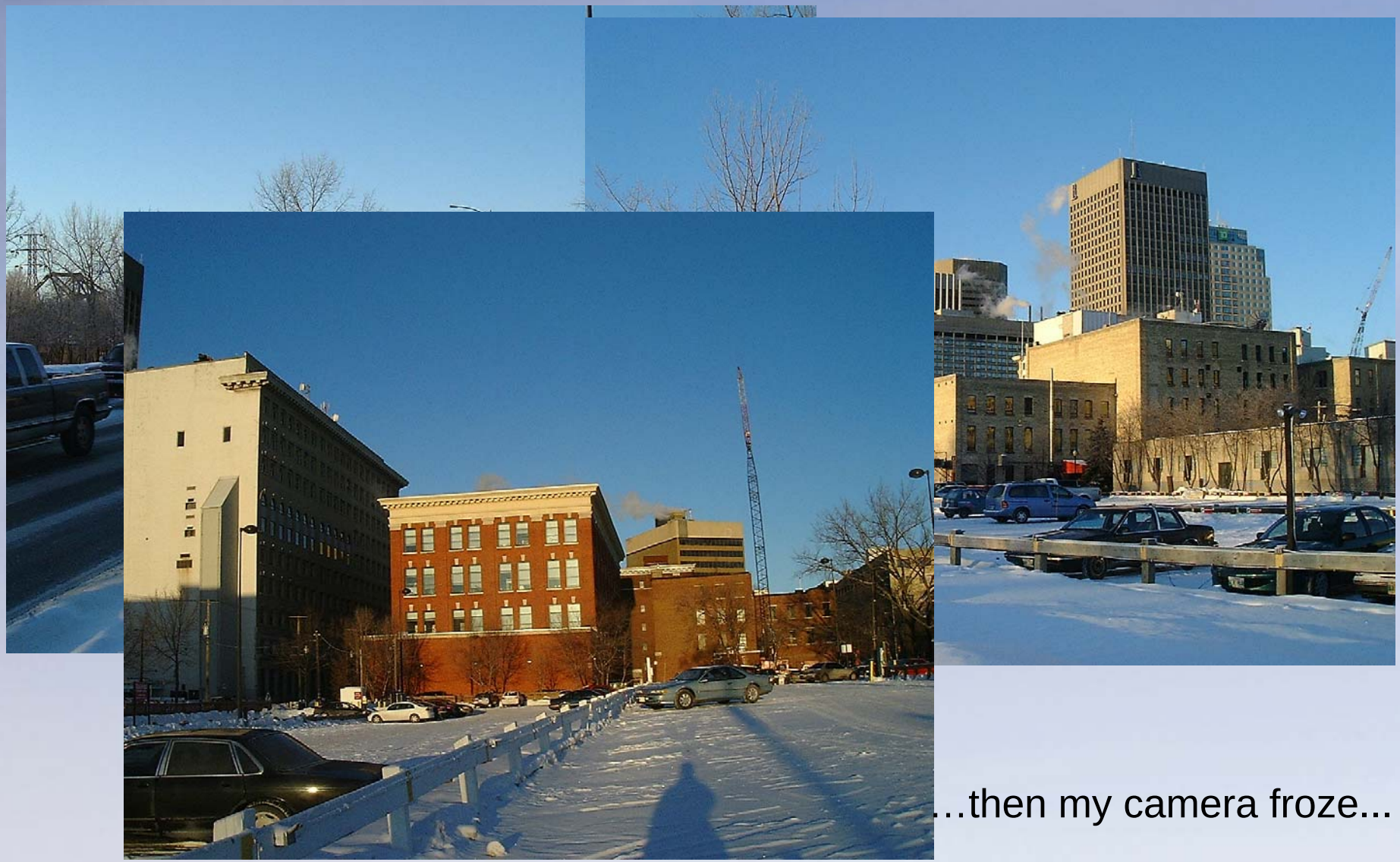
- Parks Canada Agency -



Thomas M. Naughten
Western Canada Service Centre,
Winnipeg, Manitoba, Canada

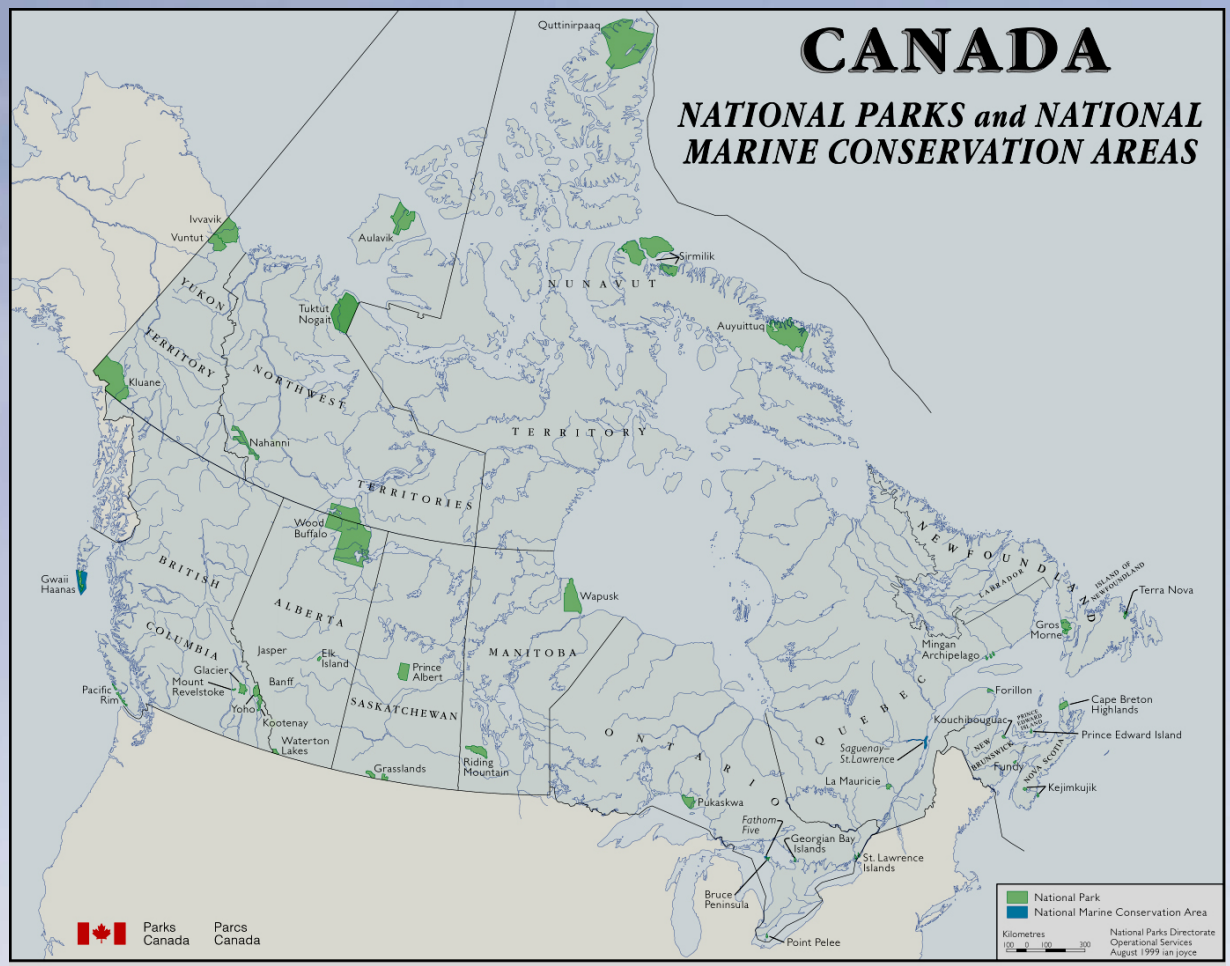
Friday morning: 7:30am –26C(-15F)

…so I am glad to be here.

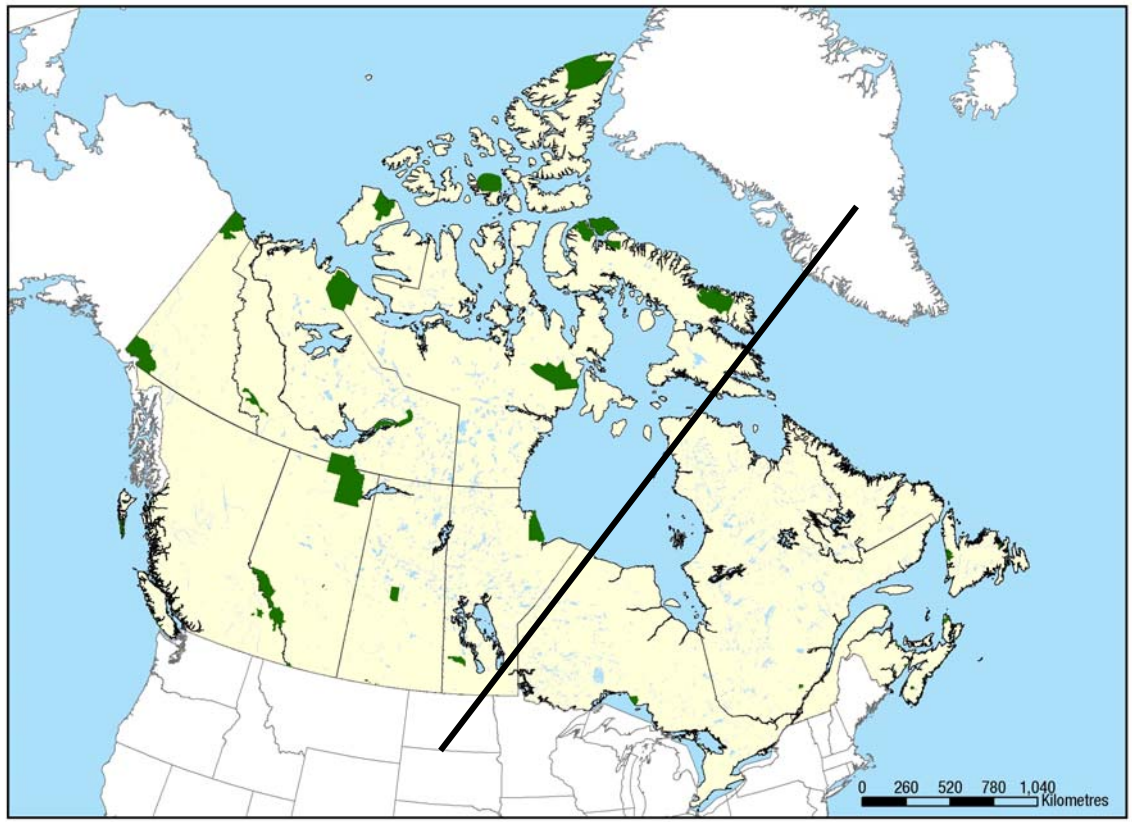


…then my camera froze...

Who we are: National Office, Service Centers, Field Units and Parks.

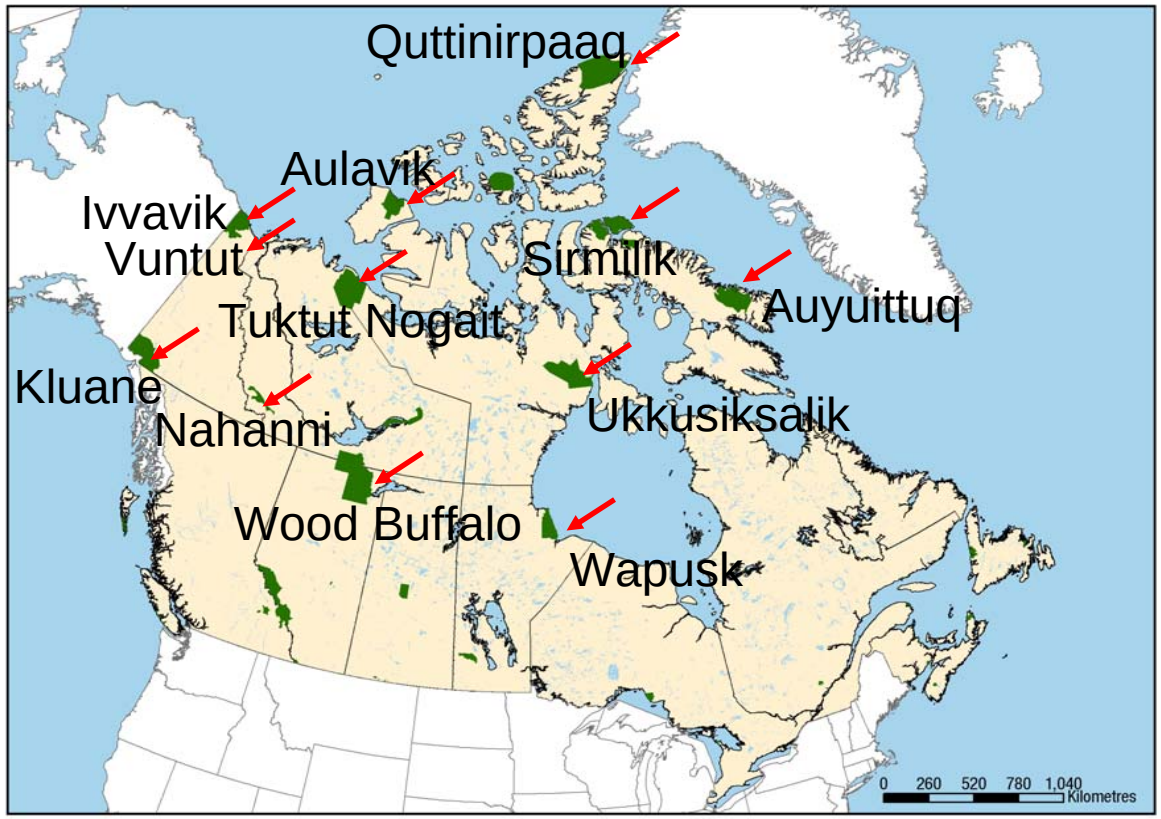


Western Canada Service Centre (WCSC): Winnipeg, Calgary, Vancouver.



The Problem for Monitoring Northern Parks is Remoteness & Size

WBF = 44,802 Km²
17,298 m²
QUT = 37,775 Km²
14,585 m²
SIR = 22,200 Km²
8,571 m²
…
NAH = 4,766 Km²
1,840 m²



Satellite Monitoring of Northern Ecosystems

- John Wilmshurst, Ecologist
- Tom Naughten, Project Manager and Data Manager
- Brad Sparling, Analyst on contract
- Project on-going from 1998 to 2005
- AVHRR dataset 1993 to 2004

History

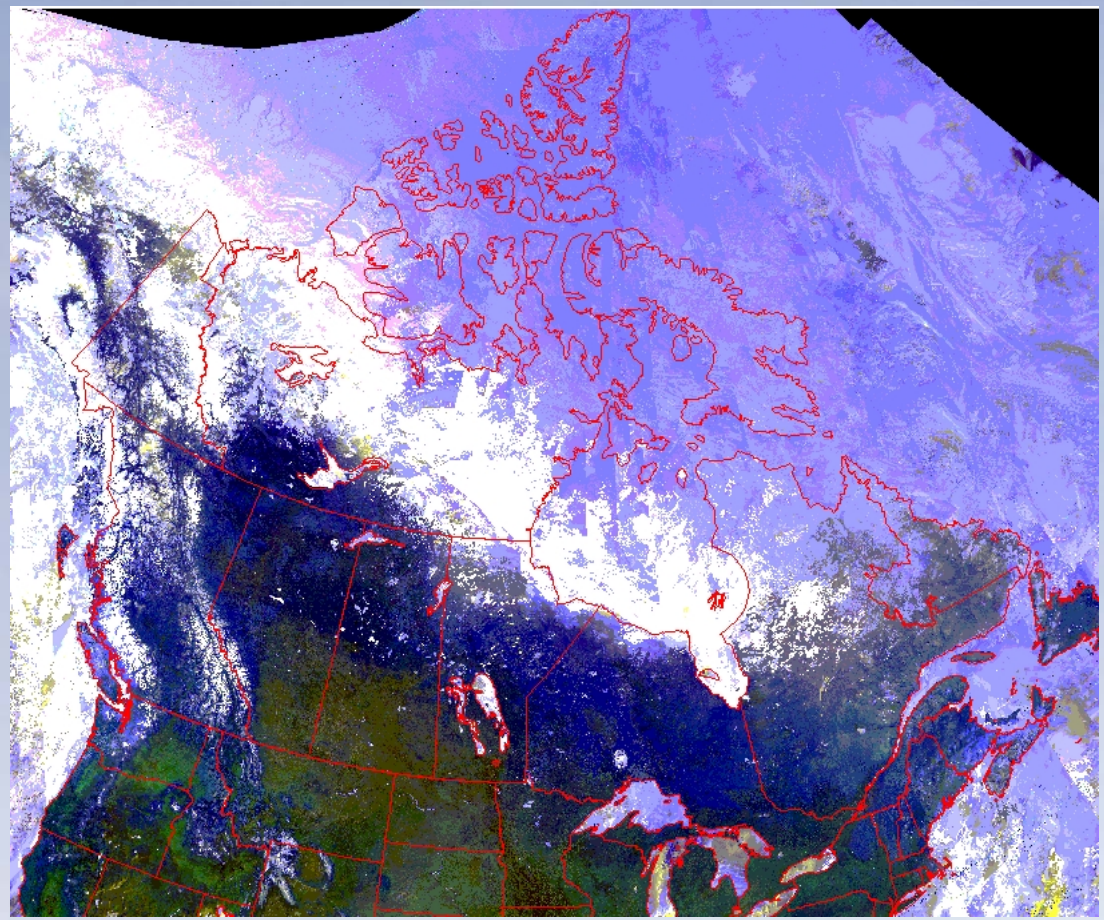
- In 1995 Stephen McCanny and David Henry, ecologists at WCSC, put together a handbook on Ecological Monitoring for Prairie and Northern National Parks.
- One of the themes was satellite monitoring.
- They recommended a) a three year rotation of TM images, b) a five year rotation of AVHRR images and c) biweekly composites of AVHRR to plot the growing season.
- In 1997/8 the WCSC funded a pilot study of AVHRR use.

Initial Proposal

- Satellite Monitoring of Northern Ecosystems project
- Analyze NDVI trends to determine changes in vegetation
- MRS subscription for AVHRR 10-day composites
- Costs shared between 11 individual Parks and National Office
- WCSC funded the Ecologist, Data and Project Manager and a technician from Red River College, Winnipeg
- Specific questions related to a park or between parks accepted
- Annual report and CD produced

Satellite Monitoring of Northern Ecosystems

- Aulavik
- Auyuittuq
- Ivvavik
- Kluane
- Nahanni
- Sirmilik
- Tuktut Nogait
- Vuntut
- Wapusk
- Wood Buffalo
- (Ukkusiksalik)
- (Quttinirpaaq)



Focus questions

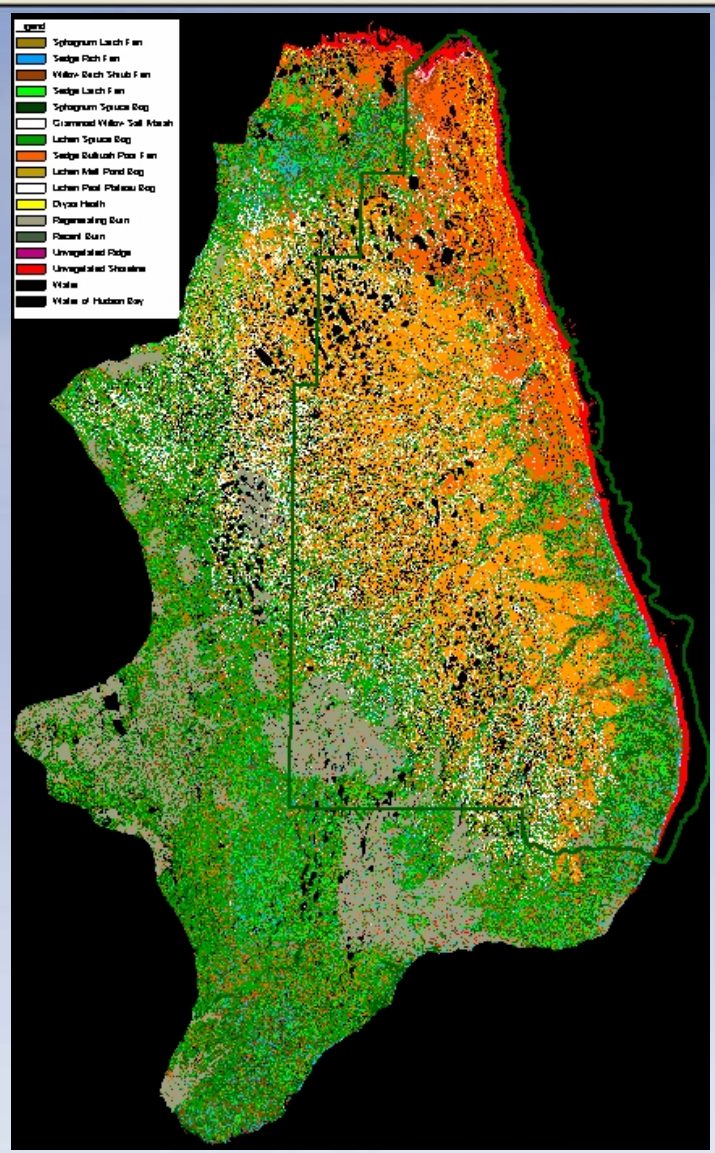
- What are the long term and large scale patterns of vegetation productivity as measured by NDVI within and among northern national parks?
- What is the timing of key events during the summer? When does green-up and ice-out occur in large lakes?
- What are the long-term patterns of daily mean temperature within and among northern national parks?
- How does climate data correspond to trends and patterns observed in the NDVI?

Issues and constraints

- Park staff are familiar with only some imagery ie. Landsat TM, orthorectified air photos …
- 30m vs. 1Km pixels; detail vs. ‘big picture’ ...

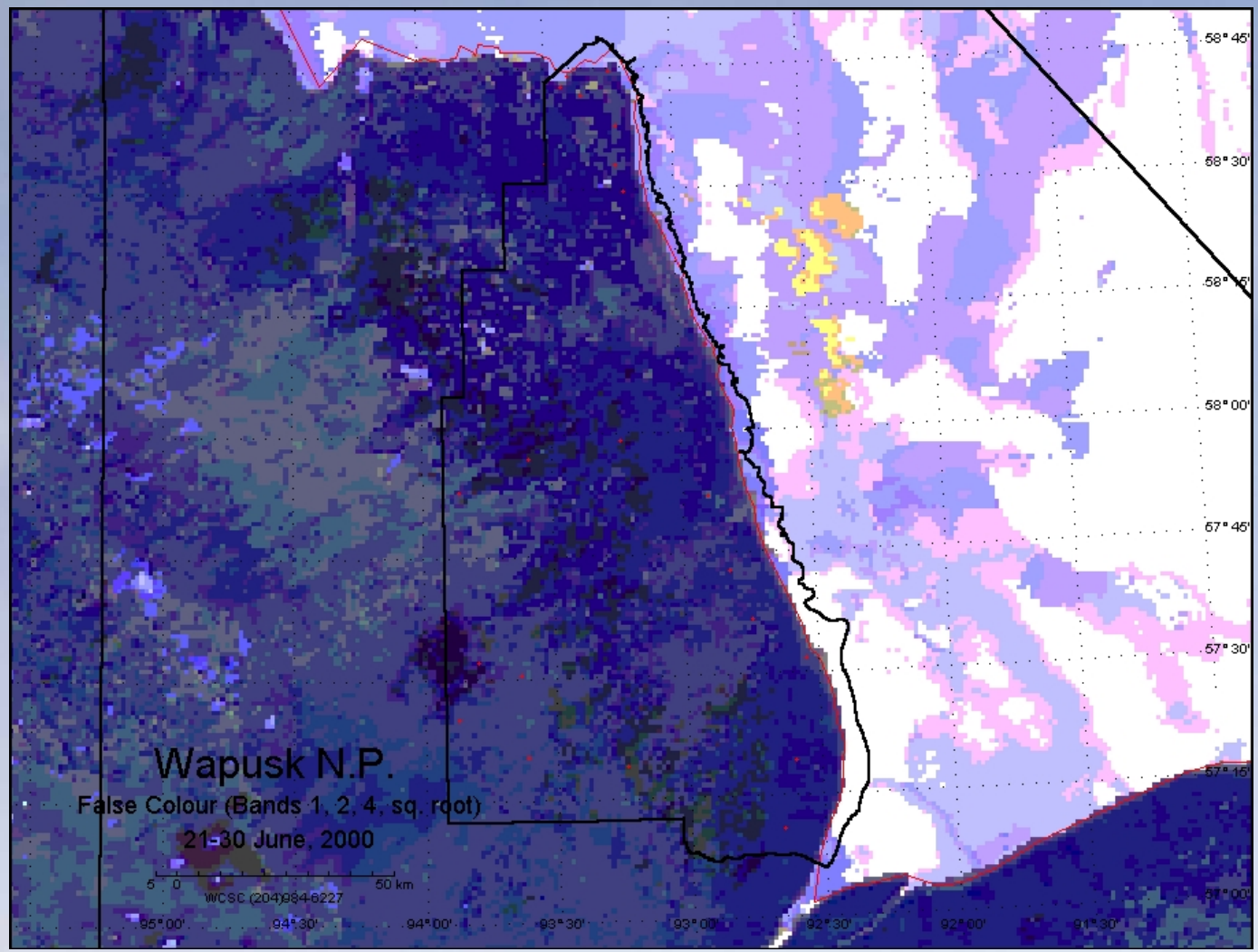
Wapusk N.P.

Wapusk Vegetation Classification



Ryan Brook M.Sc.
U. of Manitoba

Wapusk in June



Issues and constraints

- Staff are familiar with only some imagery ie. Landsat
- 30m vs. 1Km pixels; detail vs. ‘big picture’
- Hardware and software upgrades
- Technical skill set upgrades

Issues and constraints

- Staff are familiar with only some imagery ie. Landsat
- 30m vs. 1Km pixels; detail vs. ‘big picture’
- Hardware and software upgrades
- Technical skill set upgrades
- Project funding
- Monitoring must be for the long term

Results

- Significant increase in NDVI over 10 year period confirmed
- Increase more prevalent in summer and fall than spring
- Air temperature corresponded very well with NDVI
- Timing of green-up dependent on dominant landcover type and on latitude
- Determining end and length of growing season and date of peak growth are all possible
- Determination of ice-out requires large lakes

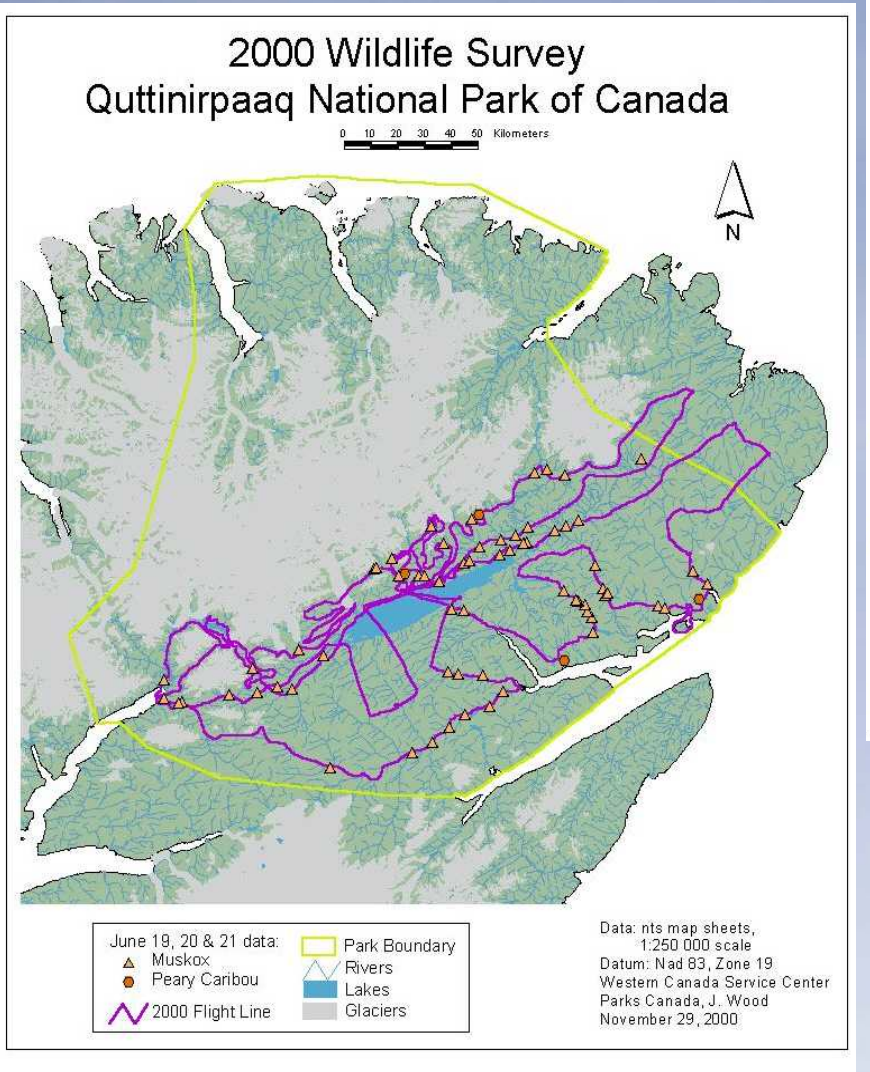
2004 Results

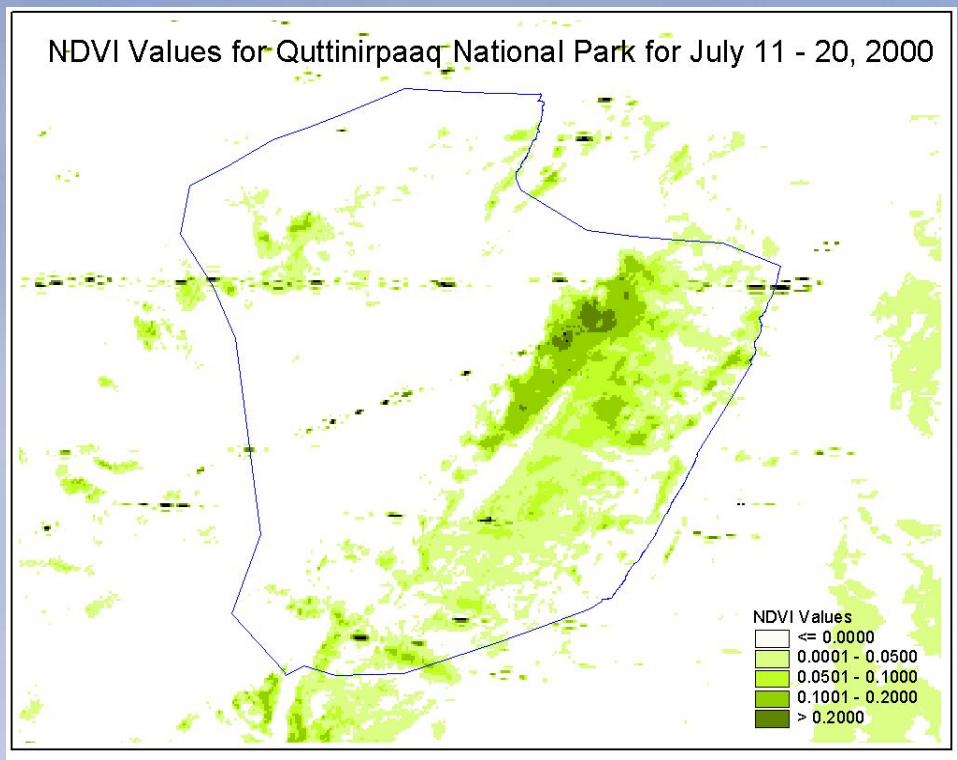
- NDVI is down this past year. A cool summer all over western and northern Canada.
- Linking AVHRR to climate data is supporting ideas;
  - There is a 30 day lag between high temperatures (sufficient to stimulate growth) and response of productivity.
  - The ability of the vegetation community to respond to temperatures sufficient for growth declines as the summer proceeds.

John.Wilmshurst@pc.gc.ca

Spinoffs

- Internal Research expanded
  - Wildlife survey of Quttinirpaaq using NDVI
    Micheline.Manseau@pc.gc.ca


2000 Wildlife Survey
Quttinirpaaq National Park of Canada
0 10 20 30 40 50 Kilometers
N
June 19, 20 & 21 data:
Muskox
Peary Caribou
2000 Flight Line
Park Boundary
Rivers
Lakes
Glaciers
Data: nts map sheets,
1:250 000 scale
Datum: Nad 83, Zone 19
Western Canada Service Center
Parks Canada, J. Wood
November 29, 2000

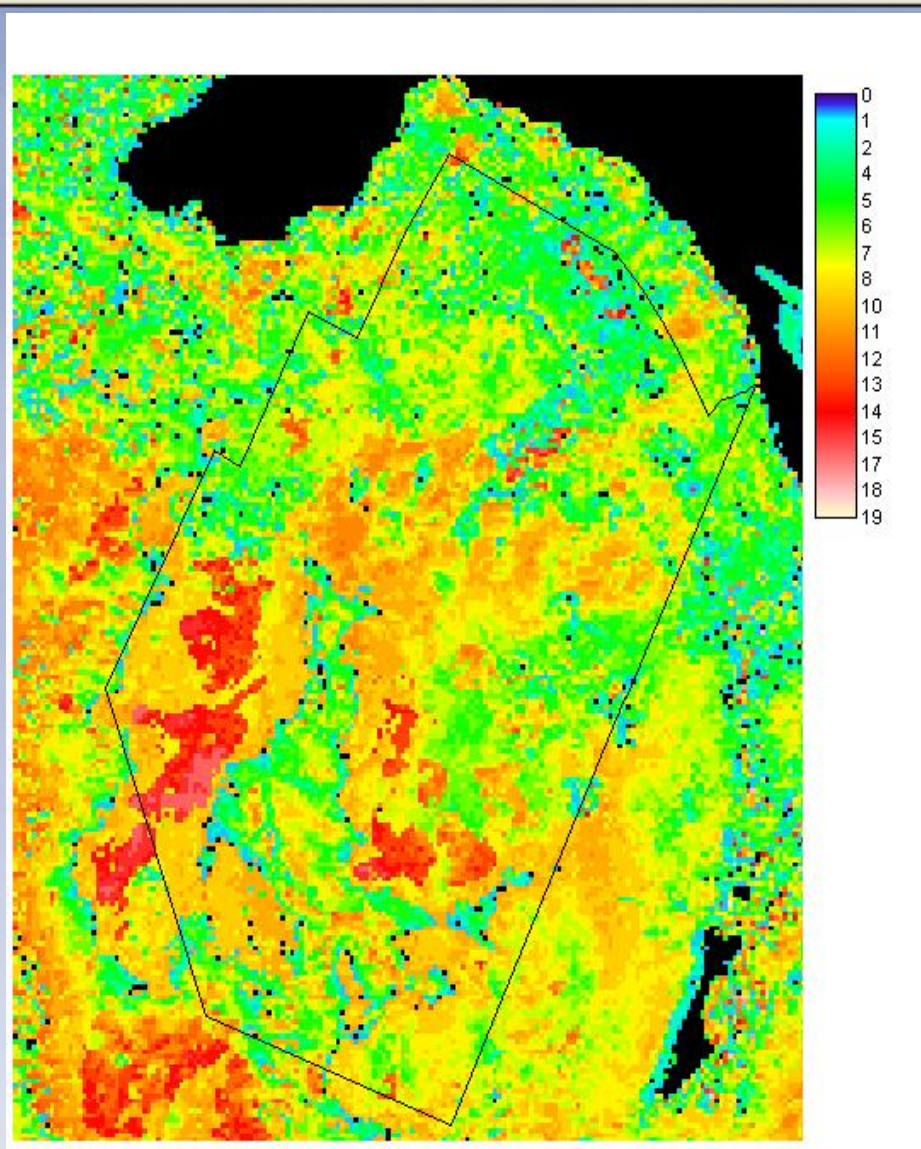

NDVI Values for Quttinirpaaq National Park for July 11 - 20, 2000
NDVI Values
<= 0.0000
0.0001 - 0.0500
0.0501 - 0.1000
0.1001 - 0.2000
> 0.2000

Spinoffs

- Internal Research expanded
  - Wildlife survey of Quttinirpaaq using NDVI (Micheline Manseau)
- Graduate work
- New research areas

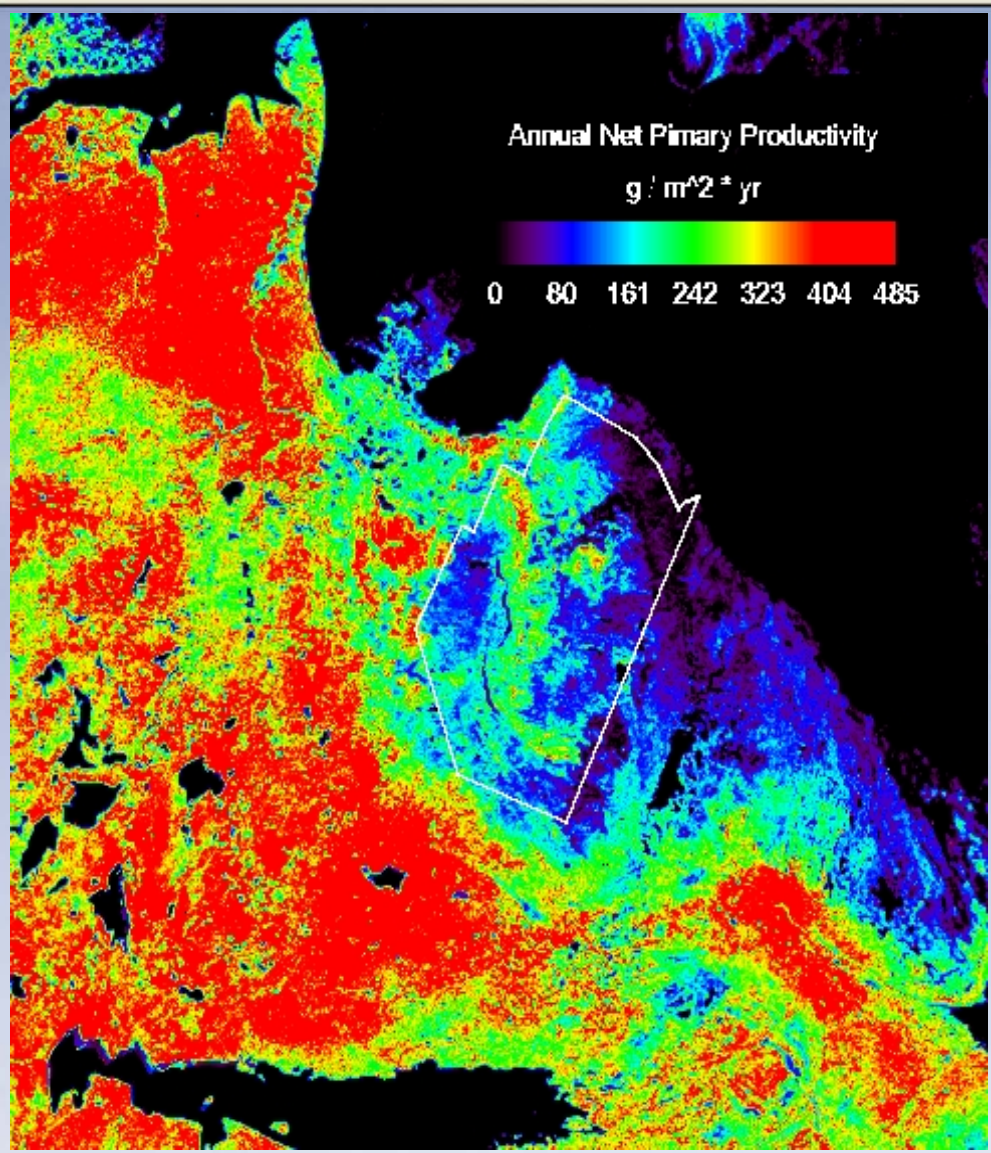
Investigating the Temporal Resolution of Composite Images

Brad Sparling
M.Sc. (2002)
University of Manitoba



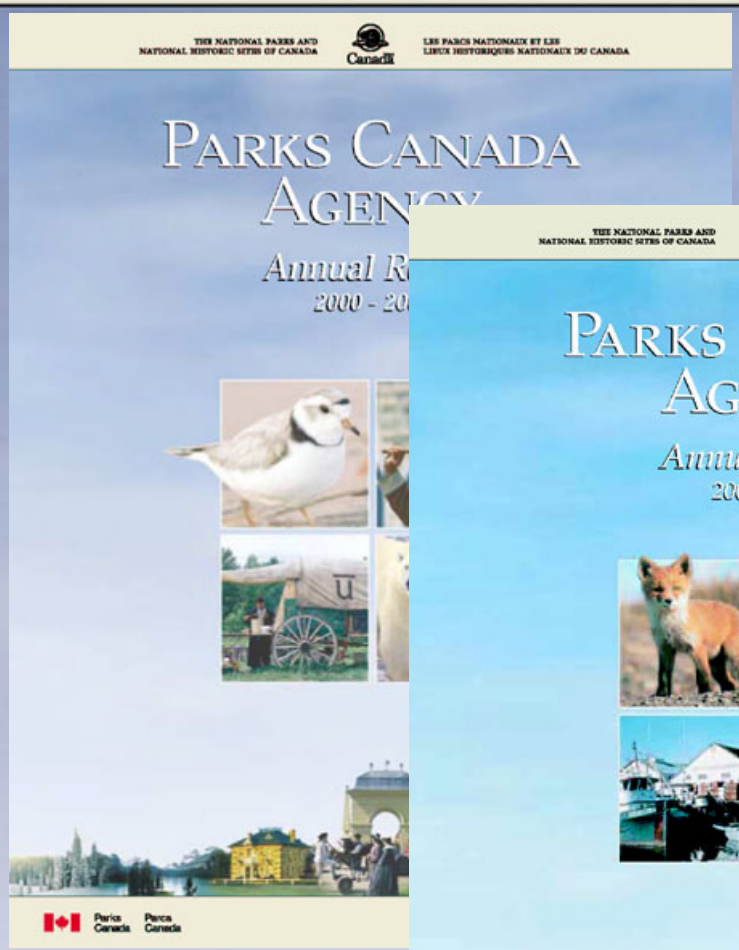
Calculate NPP using APAR and NDVI

Dan O'Brien
M.Sc. (2001)
University of Manitoba



Spinoffs

- Internal Research expanded
  - Wildlife survey of Quttinirpaaq using NDVI (Micheline Manseau)
- Graduate work
- New research areas
- NDVI for all parks in State of the Parks report
- A WCSC model for maintaining projects over the long term
- Rules for data management of large files …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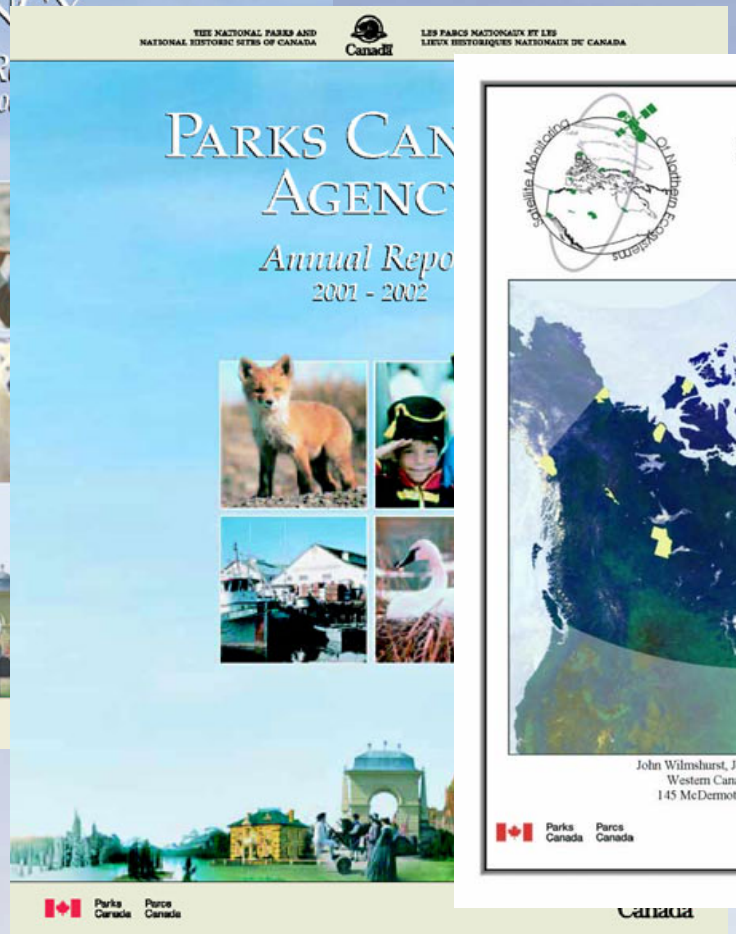
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Parks Canada
Parcs Canada


Satellite Monitoring of
Northern Ecosystems
2001
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Western Canada Service Centre, Parks Canada
145 McDermot Avenue, Winnipeg, MB R3B 0R9
Parks Canada
Parcs Canada
Canada


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RN ECOSYSTEMS
2002
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enue, Winnipeg, Manitoba, R3B 0R9
Canada

Success

- Project running from 1998-2005
- We have AVHRR data from 1993-2004
- Proposed for National level funding
- Park staff are using the information
- Managers are applying the information to projects and decisions on park research permits
- Park ecologists asking new questions; ice, fire etc.
- Building relationships with scientists and researchers in universities, other government departments and with private industry ...

Success (cont.)

- Annual reports are going beyond Parks Canada
- Increased requests for data
- Growing need for RS specialists in Parks Canada
- Introductory course in Remote Sensing will be delivered to the Northern Bioregional Monitoring Workgroup in April 2005
- A Parks Canada centre for remote sensing is suggested and the WCSC is in a position to participate
- ...

Lessons learned

- There must be an active project manager/champion
- Technical transfer is critical for successful analysis
- Find the sexy stuff, the good news and the hooks — and use them to market the project
- Sharing costs among partners is good for buy-in, commitment and a perception of value
- Research and continuous development of ideas
- Spin-off applications important
- Develop relations with the data source upstream
- A research dataset is not a monitoring data set
- Be seen as useful to external partners beyond the dollars spent on data
- Succession planning is vital

Next steps

- Work on correlating heat, moisture and NDVI
- Standardize atmospheric correction
- Quttinirpaaq; coverage and field data
- Lake ice; dates on/off
- Study changes in green-up patterns
- Net primary productivity (NPP)
- Investigate complimentary imagery; scale issues, $NDVI_{AVHRR}$=?=$NDVI_{MODIS}$=?=$NDVI_{ETM+}$ etc.
- Integrate project into Monitoring program and funding
- Develop products; animation, regular prints...
- Build tools for the field

Next steps (more…)

- WCSC supports release of AVHRR 1993-2003 dataset by Fall 2005 (Rasim Latifovic, CCRS)
- WCSC will participate in the Mid- and Low-Resolution GRIP (3) proposals (Richard Fernandes, CCRS)
- …

Thank you.

Questions or comments?

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